DEPARTAMENTO DE ECONOMIA
PUC-RIO

TEXTO PARA DISCUSSÃO
Nº. 422

THE SWINGS IN CAPITAL FLOWS AND THE BRAZILIAN CRISIS

ILAN GOLDFAJN

ABRIL 2000

The Swings in Capital Flows and the Brazilian Crisis [1]

By

Ilan Goldfajn
Pontificia Universidade Católica - Rio de Janeiro

The paper analyzes the Brazilian crisis with emphasis on the role of capital flows and the players involved. It concludes that while foreign investors (both banks and institutional investors) were long in Brazil, the speculation against the currency was not overwhelming. Once their position changed, the crisis erupted. But the change in position cannot be attributed to either a compensatory liquidation of assets story by foreign investor caused by the Russian crisis, neither to the effect of international interest rates. Brazil's better than expected macroeconomic performance in the aftermath of the crisis was partly due to the fact that the private sector was largely hedged at the moment of the crisis and was insulated from the immediate effects of the devaluation. In addition, the reasons for a low passthrough of the exchange rate depreciation to inflation are related to a depressed level of demand after the crisis that discouraged the passthrough and a previous overvaluation of the exchange rate that was corrected by the nominal devaluation.

Address:
Pontificia Universidade Catolica
Departamento de Economia
Marques de Sao Vicente, 225
Rio de Janeiro, Brazil
Phone: (5521) 274-2797
Fax: (5521) 294-2095
e-mail: goldfajn@econ.puc-rio.br

Keywords: Balance of Payments, Capital Flows, Crises, Russia, Brazil

Table of Contents

I.   Introduction

During the 1990's, Brazil experienced a complete cycle of capital flows. First, as many other developing countries, Brazil experienced a surge in capital inflows that was initially praised for eliminating a decade of restricted borrowing. Second, the new flows seem overwhelming and led to the introduction of a variety of controls over capital flows that were devised to modify their volume and composition. Finally, in the aftermath of the Russian crisis of August 1998, a series of events led to large outflows of capital that culminated in the Brazilian crisis and the floating of the Real on January 1999.

The Brazilian crisis is interesting for several reasons. First, it is another instance where one can analyze the role of capital flows in a currency crisis looking at different players - institutional investors, foreign banks and domestic investors – and different type of flows – direct investment, portfolio and bank loans. Second, it is an interesting case of contagion. In academic and policy making circles the hypothesis is that there was a contagion from the Russian crisis to Brazil. If true, this fact is, perhaps, surprising. In contrast to the contagion from the Mexican and Thai crises, the Russian contagion to Brazil appears to have crossed regional borders. It is interesting to analyze the consequences of this fact on our current understanding of crises and contagion. Third, the Brazilian crisis was milder than previous currency crises. It is interesting to understand the reasons for this performance.

Brazil's macroeconomic performance during the crisis year was better than expected. Inflation did not explode, GDP did not collapsed, the government was not forced to restructure its public debt and, slowly, both nominal and real interest rates have been going down. This performance is partly due to the fact that the private sector was largely hedged at the moment of the crisis and was insulated from the immediate effects of the devaluation. The reason for this "prudent" behavior is that the Brazilian crisis was anticipated by market participants. Since the Mexican crisis, the Brazilian economy was identified by analysts as vulnerable to crisis because of its large fiscal deficit and the short maturity of its public debt. The peg was sustained for several years based on high real rates and a comfortable level of

reserves. However, when the Russian crisis occurred, large capital outflows quickly reduced what seemed to be a comfortable level of reserves. On October 1998, Brazilian authorities reached to the IMF and a large scale package ($41 billion) was provided but that was not enough to calm markets. The crisis erupted on January 1999 and the Real was allowed to float.

In this long process pre-announcing the crisis, the private sector slowly hedge its dollar liabilities by purchasing dollar denominated securities and dollars in the future markets, all provided by the government in its attempt to keep the peg. Therefore, in contrast to the Asian crises, there were mild balance sheet effects and almost no bankruptcies once the Real floated and the depreciation reached more than 80 percent. Of course, this was no free lunch, given that the public sector bear most of the cost by increasing the public debt by 10 percent of GDP. The main fear during the crisis was the outburst of inflation fueled by the large depreciation and the return to the high inflation regime. This fear proved to be unfounded . The reasons for a low passthrough of the exchange rate depreciation to inflation are related to: (a) a depressed level of demand after the crisis that discouraged the passthrough , (b) a previous overvaluation of the exchange rate that was corrected by the nominal devaluation, (c) a low initial inflation at the end of 1998, (see Goldfajn and Werlang, 1999).

The paper concludes that in the case of Brazil one cannot assert that a particular investor group had a predominant role in the crisis. If anything, the data suggest that while foreign investors (both banks and institutional investors) were long in Brazil, the speculation against the currency was not overwhelming. Once their position changed, the crisis erupted. But why their position changed? The data does not seem to reflect a compensatory liquidation of assets story by foreign investor caused by the Russian crisis. Neither it is the effect of international interest rates. The econometric exercise on capital flows suggests that the push effects have a more long run effect, affecting capital flows only once large changes in international interest rates are factored in.

The paper is organized in seven sections. Following the introduction above, Section II describes the Brazilian crisis looking at macroeconomic and financial variables. Section III analyzes the role of institutional investors, foreign banks and domestic investors in the crisis. Section IV examines the aftermath of the crisis and the reasons for its mild effect. Section V performs an econometric exercise investigating the determinant of capital flows to Brazil in the 1990's. Section VI tests formally the existence of contagion from the Russian crisis to Brazil. Finally section VII concludes and the appendix describes the data.

II.   The Brazilian Crisis

This section examines the stylized facts regarding the Brazilian crisis. Brazil has had a history of very high inflation (hyperinflation at times) until the Real plan of July 1994.[2] The latter was an ingenious scheme of changing numeraires. In March 1994 nominal prices, wages and other contracts were allowed to be quoted in a unified reference value (URV) that would be replaced by a new currency, the Real, on July, 1994. Since prices were already indexed to several different references, the innovation of the URV was to coordinate a unified unit of account that would substitute for all other indexation mechanism. In the interim period after the introduction of the URV and before its replacement by the real, it was expected that relative prices would converge to their equilibrium value. This was important to the second phase of the conversion, when the URV would be transformed into Real on a one-to-one basis and then pegged to the dollar. This pegging, in fact, caused inflation to plunge from 46 percent in June 1994 to 1.5 percent in September 1994.

The drastic reduction of inflation since July 1994 changed the inflationary scenario and, as a consequence, contributed to deliver two presidential mandates and several seats in congress to the people and parties perceived as responsible for this change. Since then, low inflation has been considered a political asset. However, the fall in inflation was not fast

---

[2] On the Real plan see Franco, G.B.F. (1996) and Clements, Benedict (1997).

enough to avoid a real appreciation of the exchange rate that prompted the central bank to set an adjustable band for the dollar value of the real and maintain a continuing crawling peg within it from 1995-1999 (see Figure 1). Notwithstanding the crawling peg that was set at approximately 7 percent per year, the real exchange rate remained clearly overvalued as can be seen from the increasing current account deficits (from around 2 percent in 1995 to 4.5 percent in 1998). The overvaluation contributed to the lack of GDP growth (see Table 1).

On top of the lack of competitiveness and poor GDP growth, fiscal performance deteriorated in 1997 and 1998 which led the Brazilian economy to be vulnerable to external shocks. There were three major external shocks after the Real plan, the Tequila effect in 1995, the Asian crisis in 1997 and the Russian crisis in 1998. The reaction to the crisis was similar in all cases. Nominal interest rates were doubled (see Figure 2) and a fiscal package promised. This strategy was successful in averting a crisis after the Tequila and Asia shocks. However, after the Russian crisis, this same strategy had a perverse effect. Instead of attracting capital, the strategy this time induced capital outflows. The reason was that the fiscal package was not credible and the higher interest rates increased nominal fiscal deficits and raised fears of a sovereign default. As a consequence, large withdrawals followed and the currency came under pressure.

Table1: Major Macroeconomic Indicators

	1995	1996	1997	1998	1999	2000
Current Account Deficit (% GDP)	2.55	2.98	3.85	4.34	4.39	3.50
Non-FDI External Borrowing Requirements (US$ billions)*	12.50	12.80	13.80	7.70	-5.60	-4.00
GDP Growth	4.22	2.66	3.60	-0.12	0.82	3.50
Primary Fiscal Deficit (% GDP)	-0.35	0.09	1.00	-0.02	-3.13	-3.20
Nominal Fiscal Deficit (% GDP)	7.05	5.87	6.67	8.65	10.01	4.50
CPI (IPCA)	22.41	9.56	5.22	1.66	8.94	6.80
Unemployment (average)	4.64	5.42	5.66	7.60	7.55	7.00
Real Interest Rates (accumulated)	25.50	16.80	19.60	25.80	15.80	10.50
Nominal Interest Rates (accumulated)	53.08	27.41	24.78	28.92	25.54	18.00

* Current account deficit minus FDI

Sources: Author's Calculation, Banco Central do Brasil and Instituto Brasileiro de Geografia e Estatística

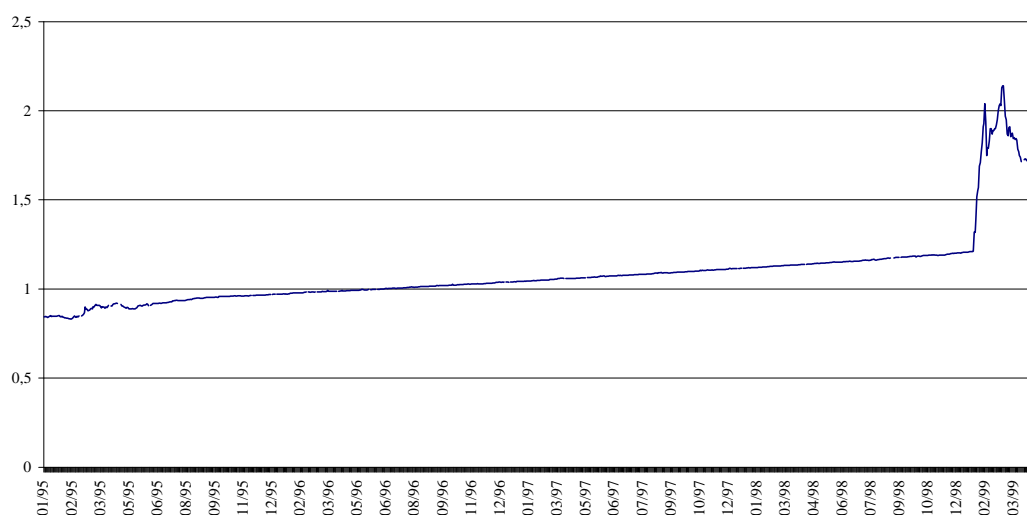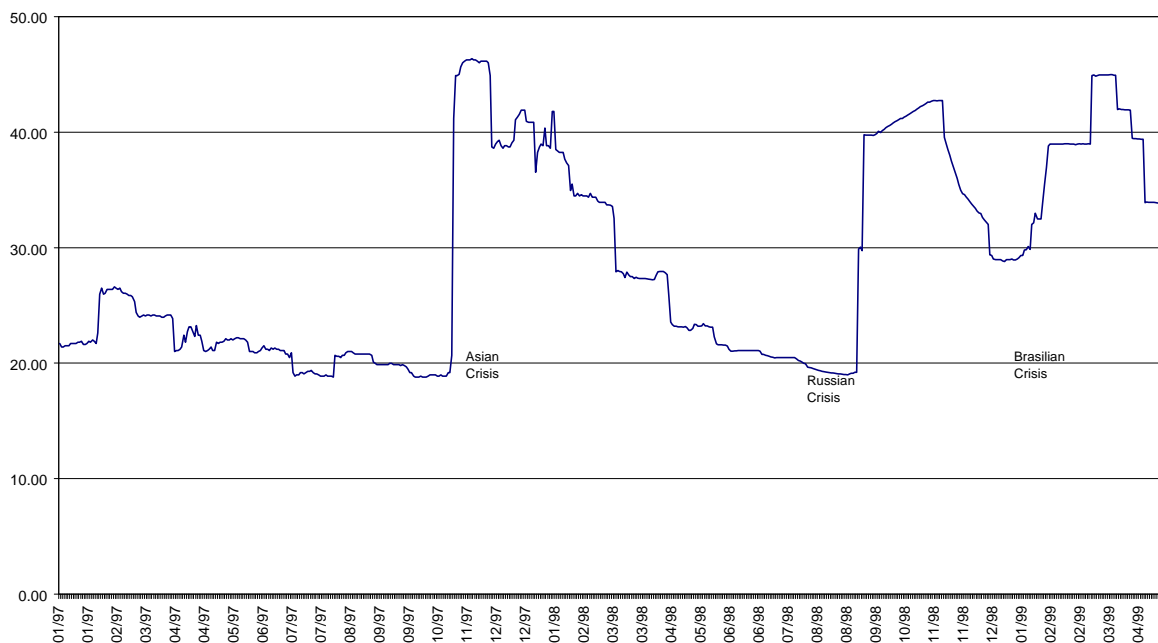**Figure 1: Brazilian Exchange rate**

Figure 2: Brazilian interest rates

The crisis was triggered by foreign investors that were exposed to Russian risk and suffered major losses from both the restructuring of the Russian debt or/and the devaluation of the Ruble. Others were surprised by the fact that it occurred within an IMF program and panicked regarding other emerging markets. The effect on the exchange market in Brazil was extreme. On August and September alone, the excess demand for dollars in the foreign exchange market was 11,8 and 18,9 billion dollars, respectively. This obviously implied a huge loss of reserves during these months and the following one (see Figure 3).

Analyzing the composition of flows at that time is interesting. Table 2 and Figure 4 show that the crisis hit very hard net portfolio flows and debt securities that deepened immediately after the Russian crisis and only recovered in late 1999. In contrast, the share of net direct investment increased steadily surpassing $20 billion in 1998 and $25 billion in 1999. This would suggest that the crisis is driven (or at least validated) by outflows of equity and debt securities that are more volatile and react strongly during crisis, at least when

compared with direct investment flows. This gives support to the notion that policy makers should use caution when the economy's external accounts are financed by more volatile flows (this call for caution often includes support for capital controls to put some "sands on the wheels" on the swiftness of these flows).

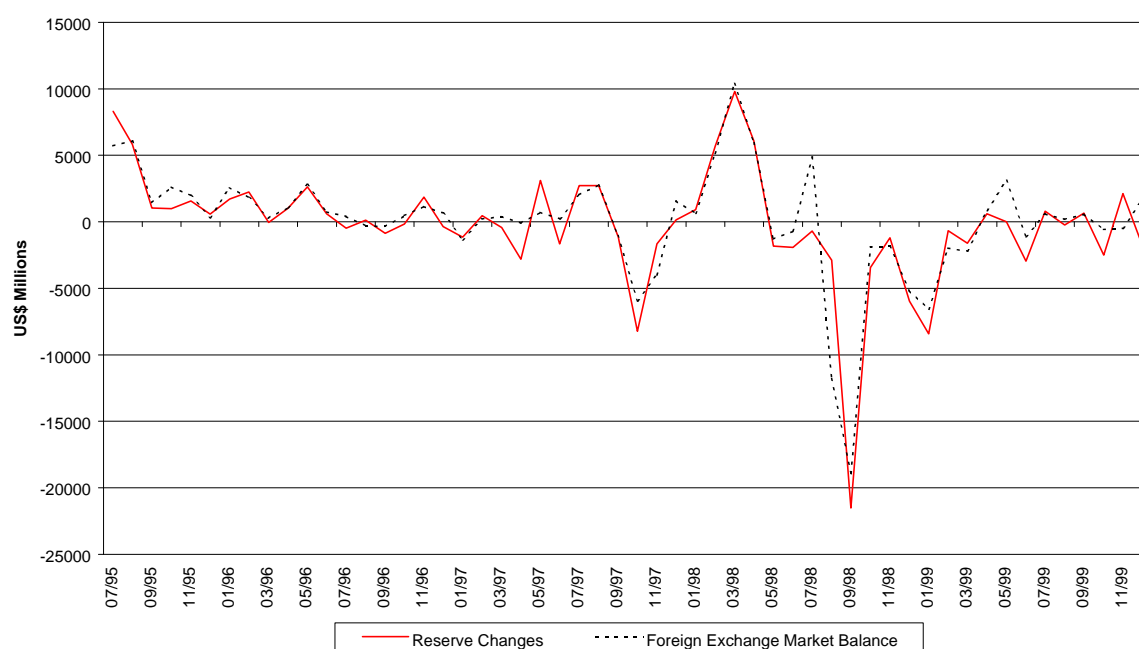**Figure 3: Foreign Exchange Market and Reserve Movements**

Table 2 : Capital Flows								
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Net Direct Investement	-408	1268	-481	852	2376	9519	15364	22988	25946
-FDI	505	1156	397	117	5475	10349	17086	26134	27109
-Reinvestment	365	175	100	83	384	531	151	124	NA
-NBI	-913	112	-878	-1065	-1560	77	-1569	-3212	-1163
Net Portfolio Securities	578	1704	6651	7280	2294	6040	5300	-1861	1529
Debt Securities	2368	5761	5866	3713	3113	12727	19771	28968	-7982
Short term Capital and Others	-7406	-2844	-4432	-3825	21523	4856	-15517	-30032	NA
Total	-4868	5889	7604	8020	29306	33142	24918	20063	NA
Reserve Changes	-567	14348	8457	6595	13034	8270	-7937	-7616	-8214
Current account deficit	1407	6144	592	1688	17972	23136	30916	33611	24378

Source: Banco Central do Brasil

Note: FDI and NBI stand for Foreign and Brazilian direct investment, respectively. Portfolio investment, comprise investment in equity securities (Annex I-VI) and funds. Debt securities include medium and long term loans and financing. Short term capital and others equals the IFS "Financial Account" minus the sum of direct investment, equity securities and debt securities.

Figure 4. Composition of Capital Flows
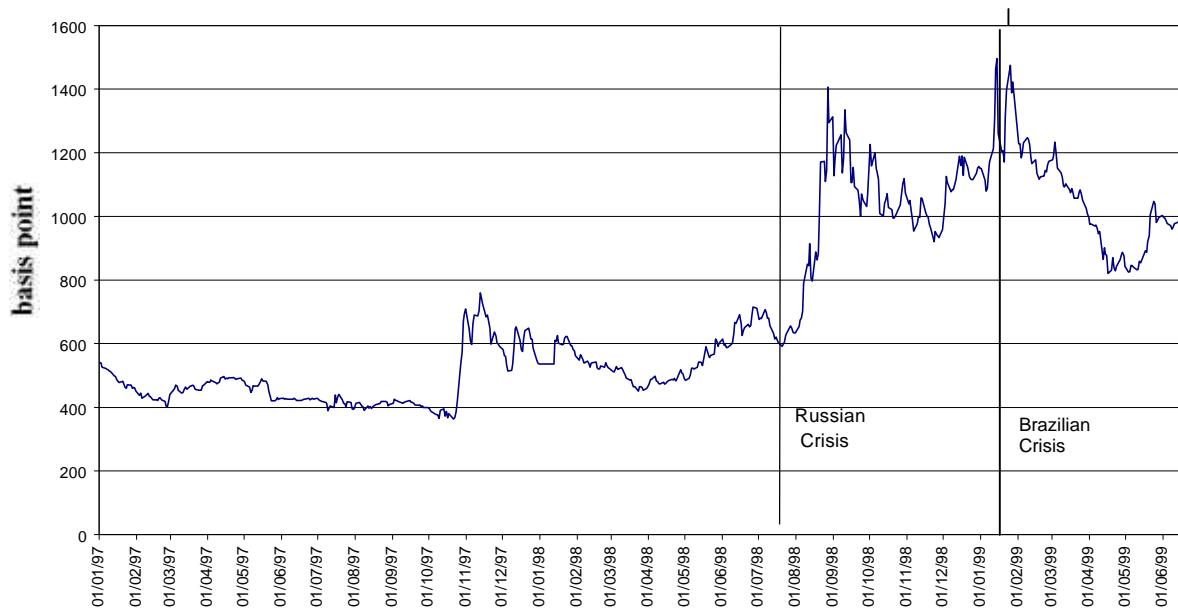6 month moving average
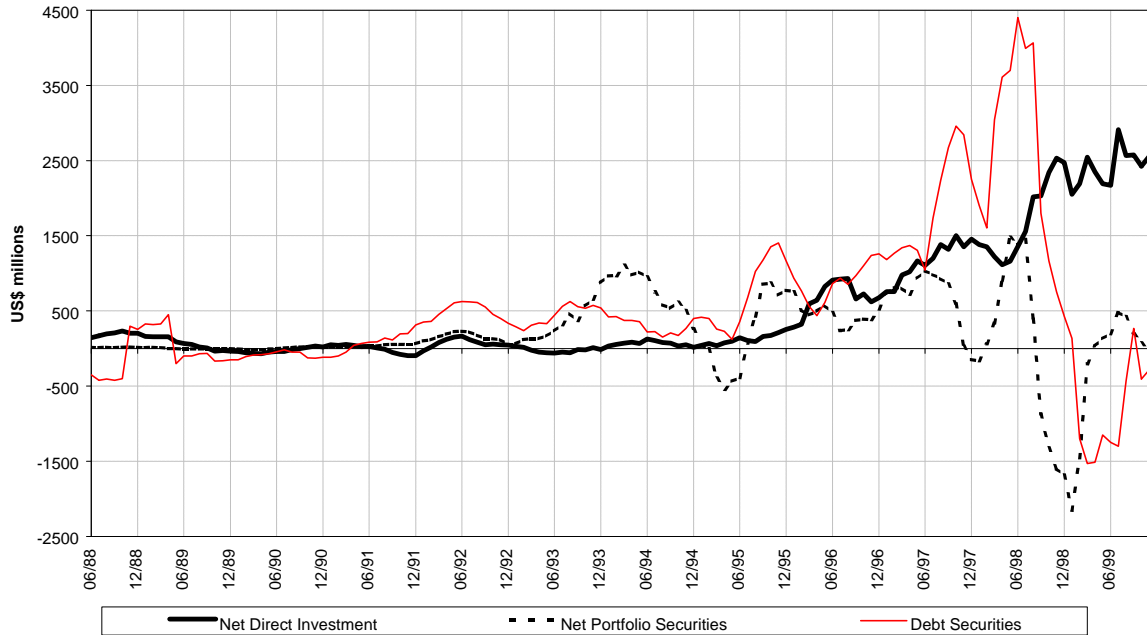
The effect of fast outflows can be observed on the movement of reserves and spreads on Brady bonds in Figures 5-6. It is important to remember than in pegged regimes (or crawling pegs), the appropriate variables to infer pressure are indeed either reserve movements or interest rate levels. The latter are better used when looking at non-policy interest rates, that are more market determined and less influenced by short term objectives of policy makers.

With daily data, one can check the alternative hypothesis that it was the liquidity crisis in mature markets that timed the crisis in Brazil and not the Russian crisis. The LTCM crisis deepened along September 1998 (the rescue plan was announced the 23rd of the month) while the Russian default happened a month earlier, on August 17. Figures 5 and 7 reveal that most of the action happens immediately after the Russian crisis both in the foreign exchange market and the brady bond one, although the spreads on the latter market suffer a new blow during the LTCM crisis, specially the shorter maturity Brazilian IDU bond. Rather

than concluding in favor of LTCM effect on this market, the fact that the reaction occurs a couple of weeks before the LTCM crisis is revealed and the behavior of withdrawals, leads us to favor instead the argument that the Brazilian residents reinforced the speculation once they realize that the speculation now included also foreign and institutional investors.

Other Brazilian financial variables reflect the Russian crisis with different lags. The floating of the exchange rate occurred only in January, 1999, five months after the Russian crisis. At the beginning, interest policy rate (overnight rate on federal funds - SELIC) was raised to levels close to the ones reached during the Asian crisis, but this time speculation forced the change in the exchange regime.

Figure 5: Spreads (C- Bonds)

Figure 6: Brazilian international reserves (US millions)

Figure 7: Brazilian Foreign Exchange Market

In sum, in this section we argued that Brazil was vulnerable to a crisis given its fiscal policy and overvalued exchange rate. The timing of the crisis was given by an external event, the Russian crisis, and triggered by large withdrawals of portfolio and debt securities assets by both domestic and foreign investors. In the next section the paper concentrates on the players involved trying to disentangle the relative role of foreign, domestic and institutional investors.

III. The Role of Domestic, Foreign and Institutional Investors in the Brazilian Crisis

Different agents have played different roles in other crises in the past. During the debt crisis of the 80's, it is well known that the crisis involved predominantly traditional bank loans. Bank overborrowing (and overlending) was at the heart of the crisis. In contrast, in more recent Mexico and Thailand crises, institutional investors had a predominant role. Here we investigate the players involved in the withdrawals of funds from Brazil during the crisis.

Table 3 is an attempt to disentangle the role of domestic, foreign and institutional investors in the various phases of the Brazilian crisis. One can observe large withdrawals out of Brazil from all agents involved, in particular after the Russian crisis and up to the Brazilian crisis, in the first quarter of 1999. The magnitudes are overwhelming. Institutional investors withdrew U$ 13.1 billion, Banks withdrew U$ 10.9, Brazilian investors withdrew 7.0 billion. In addition, large withdrawals in the amount of $16 billion from the so-called CC5 accounts were observed during the same period.[3] Therefore, in the case of Brazil one

---

[3] These CC5 deposit accounts were created in the past to allow nonresidents to invest in Brazil. Their regulations are very lax, but they are subject to high taxes. In practice they are owned predominantly by Brazilian residents disguised as residents of other countries. Foreign investment is mostly channeled through special fixed income and equity funds with lower tax incidence. Therefore, in the past few years there are only withdrawals from the stock of CC5 accounts.

cannot assert that a particular investor group had a predominant role in the crisis. If anything, Brazilians were responsible for a large share of the withdrawals, if one includes the CC5 accounts.

In Table 3, one can observe the relative behavior of the players in the last few years. It is clear that institutional investors (and also foreign banks) had a very atypical behavior during the Russian crisis. It is interesting to compare with what occurred after the Asian crisis. During that period the speculation against the currency was concentrated in the CC5 accounts. The withdrawals from both institutional investors and foreign banks were rather modest, specially if compared with the effect of the Russian crisis. This raises the hypothesis that while foreign investors (both banks and institutional investors) were long in Brazil, the speculation against the currency was not overwhelming and Brazilian policy makers could sustain withdrawals from Brazilians investors running from fear of devaluation. Once the position of foreign investors changed, the balance of forces was altered and the currency peg could no longer be sustained (although it took long 5 months from the Russian crisis to the Brazilian devaluation).

Table 3: Net Inflows to Brazil by Type of Investor (in U$ Millions)

Period	Institutional Investors [1]	Brazilians [2]	Banks [3]	Companies	Other Foreign [4]	CC5 Operations [5]
Annual Average 96-99	2,752	-2,598	-2,177	2,645	10,381	-17,356
Asian Crisis	-1,725	-1,192	-271	1,616	-1,226	-12,445
Russian Crisis	-10,601	-4,965	-6,889	815	5,502	-12,580
Brazilian Crisis	-2,567	-2,025	-3,999	1,617	-6,398	-4,315
Dec 98	-1,008	-175	-1,665	1,130	-629	-1,774
Jan 99	-1,606	-1,367	-1,916	307	-706	-2,019
Feb 99	47	77	-417	180	-5,062	-522
1999	1,522	-1,951	-1,990	1,398	1,520	-10,373

1/ Portfolio Investment.
2/ Portfolio investment plus medium and long term flows.
3/: Net Medium and Long Term Loans to Banks and Credit Lines (Short Term)
4/: Includes Medium and Long Term Bonds, Commercial Papers, Notes, Securitization and Others
5/: Operations with non-resident accounts.
Note: Asian Crisis from August/1997 to December/1997; Russian Crisis from August/1998 to October/1998.
Brazilian Crisis from December/1998 to February/1999
Source: Banco Central do Brasil

Further information may be obtained from movements in the dual foreign exchange market. At the time of the crisis, the central bank was setting an adjustable band for the dollar value of the real and maintained a continuing crawling peg within it. There were two foreign exchange markets, the "official" and the floating market. Their difference was given by the type of transaction allowed. In the official market mostly proceeds of exports and imports of goods and services were allowed but also a few capital account transactions. One important example is most of the portfolio investment by foreign investors which was channeled either through two classes of fixed-income funds or through one of the five alternatives established under National Monetary Council Resolution 1289. In the floating market most of the rest of the capital account transactions was transacted, in particular, those made by Brazilian residents. The Brazilian government would keep the exchange rates on both markets aligned and would not allow big differences between them.

It is clear from Table 4 that the extent of withdrawals in the in the official market during the Russian crisis was severe, reflecting withdrawals from foreign investors. This is in contrast to their behavior through the Asian crisis, where the withdrawals were about the average for this market. On the other hand, the floating markets had already showed large withdrawals during the Asian crisis but were reversed a few months later. During the Russian crisis the large withdrawals did not reversed and were fueled by fears from parallel withdrawals in the official markets. Therefore from the dimension of the players involved, the information obtained from the two separate exchange markets would suggest that, in fact, the withdrawals from foreign investors made the difference in terms of the effect of the Russian crisis relative to the Asian crisis. This contributes to the hypothesis that the contagion from Russia was triggered by foreign investors panicking from the Russian crisis. The floating market investors, that include Brazilian residents, had already jump chip during the Asian crisis and repeated the pattern during the Russian crisis, which, of course, contributed to the pressure in the exchange markets

Table 4: Brazilian Foreign Exchange Market

		Floating Market rate	Official Rate	Exchange Rate	Foreign Res.Changes
Average Jul/95 -	Jul/98	-1,322	2,670	1,348	992
Average Aug/98 -	Dez/98	-3,601	-4,327	-7,928	-6,996
Average Jul/95 -	Nov/99	-1,593	1,324	48	-198
Asia Crisis	Set/97	-1,651	613	-1,038	-1,125
	Out/97	-4,912	-1,039	-5,951	-8,241
	Nov/97	-3,700	-292	-3,992	-1,655
Russia Crisis	Jul/98	-1,839	6,693	4,855	-688
	Ago/98	-2,821	-8,989	-11,810	-2,877
	Set/98	-8,578	-10,348	-18,926	-21,522
	Out/98	-2,867	971	-1,896	-3,426

Source: Banco Central do Brasil

In Millions of US Dollars

Therefore, we are confirming in this section that although the Brazilian economy was vulnerable to shocks and Brazilian investors were always prone to withdraw their funds from their country, the timing of the crisis was given by the Russian crisis and from the withdrawals of foreign investors, in particular, institutional investors.

The Role of International Banks in the Crisis

Throughout the crisis, foreign investors reduced their exposure to Brazil, as maturing obligations came due. Tracking this process may give us information regarding the players involved in the crisis. The Central Bank of Brazil follows the maturing short term external liabilities of its banking system in a weekly basis. The short term obligations include interbank and credit lines. This survey based monitoring system was introduced on October 1998, after the Russian crisis and during the negotiations with the IMF.

Table 5 shows the cumulative reduction in short term exposure to Brazilian banks by nationality. Over the sample period the rolled over portion was $4 out of the total $6,6 billion that was maturing, amounting to a rollover rate of around 62%. U.S. banks reduced their exposure by US$931 million, with a rollover rate of 60%. Within the US, the reduction in exposure was concentrated, but nonetheless widespread. Almost one-half of the reduction came from two banks and ten banks accounted for 84 percent of the total decline. As expected, many regional banks reduced their exposure.

The rollover rate for US banks was well below the rollover rates of Germany (79 percent) and the UK (77 percent), although it was roughly in line with Japan (58 percent), France (54 percent) and Italy (60 percent). This is interesting because it bears on our fundamental question regarding the contagion from Russia to Brazil and the hypothesis that liquidity needs and withdrawals were one of channels of contagion. German banks had a larger exposure to Russia, were badly affected by the Russian crisis, and had the largest maturing amount of debt after the US. Their rollover rate, however, does not reflect a compensatory liquidation of assets since it is far above average.

The fact that the data does not support a common lender channel through Germany does not contradict our previous finding that foreign investors triggered the Brazilian crisis. The common lender is just one of possible channels of contagion. It could well be the case that foreign investors adjusted their probability of Brazilian default once they observed the Russian crisis (for example, because of a default under an IMF program) or the Russian crisis could have triggered a pure herding behavior by foreign investors.

The frequency of the data also allows us to follow the timing of the reduction of exposure, although with a lag given that the first data is from the third week of October. Figures 8-9 show the net outflows per week and the rollover rate over time. The weekly changes in exposure have been volatile, with a particularly sharp deterioration in October and over the final two weeks of the year, which was a end-year window dressing. The high rollover weeks happen in April after the Brazilian agreement with international banks to maintain short term lines. For the 11-week monitoring period ending January 1, 1999, the aggregate rollover rate was 72 percent. The weekly observations, however, have been volatile, ranging from 50 percent to 90 percent. It is interesting also to note that the international banks has not increased the exposure to their previous level before the Russian crisis. This is in part due to lack of demand for short term borrowing by Brazilian banks after the floating of the exchange rate and the associated higher exchange rate risk.

**Table 5: Changes in Exposure of Short Term Loans (Interbank + Trade) to Brazil***

	Maturing	$ Rolled Over	Rollover Rate
USA	2352	1421	0.60
Canada	168	74	0.44
France	947	516	0.54
Germany	1060	835	0.79
Italy	215	129	0.60
Japan	715	416	0.58
Netherlands	222	69	0.31
Portugal	97	90	0.93
Spain	350	145	0.41
UK	505	389	0.77
Total	6630	4082	0.62

* From October to December 1998

Source: BIS

In Millions of Dollars

Figure 8: Brazilian Weekly Short Term Bank Loans

* Short term interbank and trade credit lines
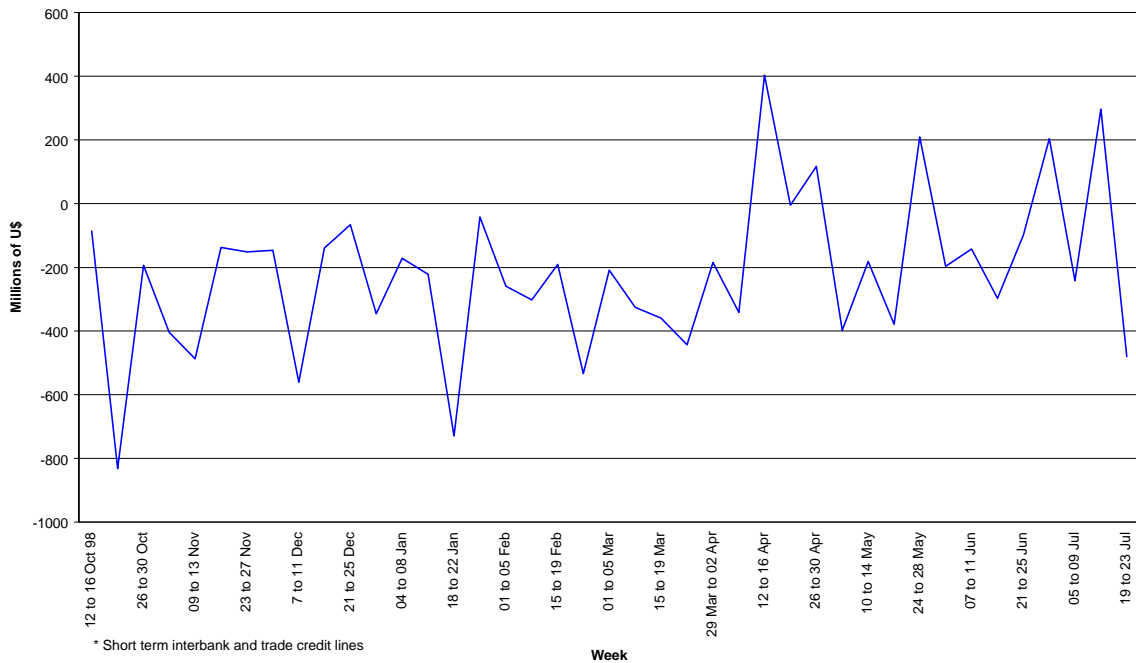
Figure 9: Brazilian Crisis and Short Term Rollover Rates
(accumulated rate)
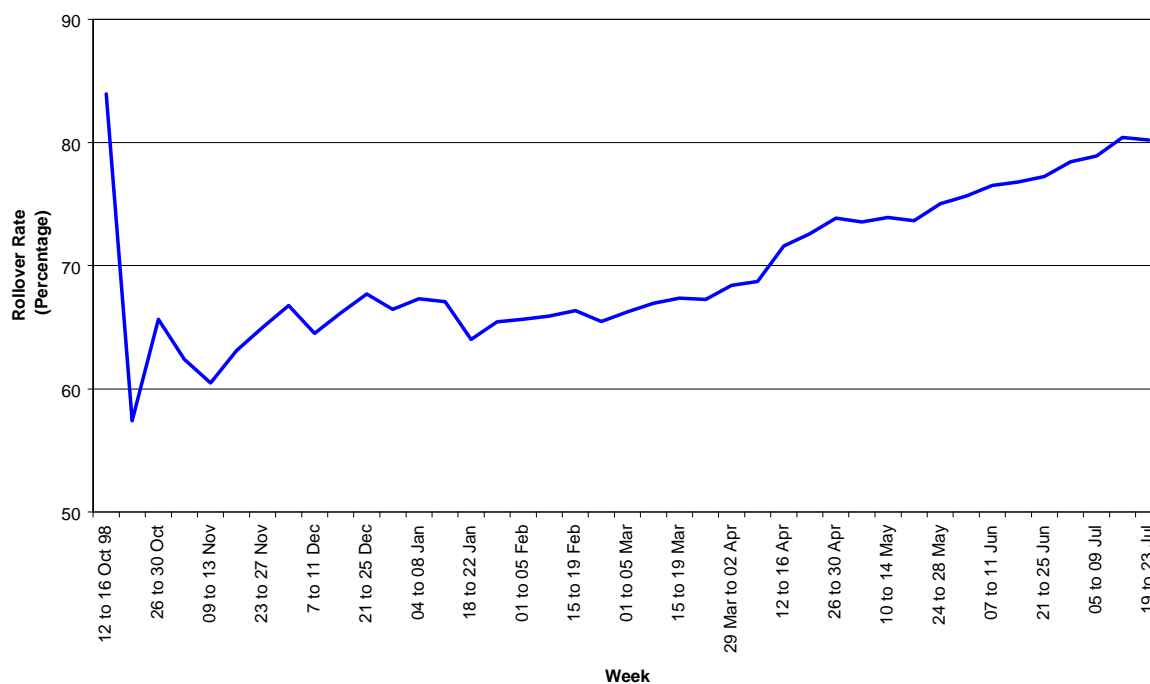
BIS data and overall bank exposure

The weekly monitoring system by the central bank of Brazil has the advantage of a higher frequency but the coverage is not universal, only short term assets are included. In contrast, the reporting banks of the Bank of International Settlements (BIS) is only published twice a year but has a broader coverage. Table 6 and Figure 10 show the overall exposure of reporting banks on Brazil and other emerging markets. The exposure on Brazil has decreased by around $10 billion dollars from the first semester of 1998 to the first semester of 1999, while the exposure in Russia decreased by almost $15 billion dollars in the same period.

It is interesting to note the similar path for the banks exposure to Russia and Brazil, in contrast to the rest of Latin America, in particular Mexico and Argentina. The reduction of the exposure to Asia diminished about a year earlier. The different paths for the exposure on Brazil and the rest of Latin America provides support to the fact that the

contagion from the Russian crisis was not generalized, as it would be if driven only by liquidity needs.

Table 6: BIS Banks Holding (US$) in Emerging Markets Data

	Brazil	Mexico	Russia	Argentina
97.1	71862	62161	69081	44844
97.2	76292	61794	72173	60413
98.1	84585	62892	75853	60222
98.2	73313	64962	58594	61517
99.1	62310	63776	55424	66683

in billions of dollars

Figure 10: BIS Banks Holdings in Emerging Markets
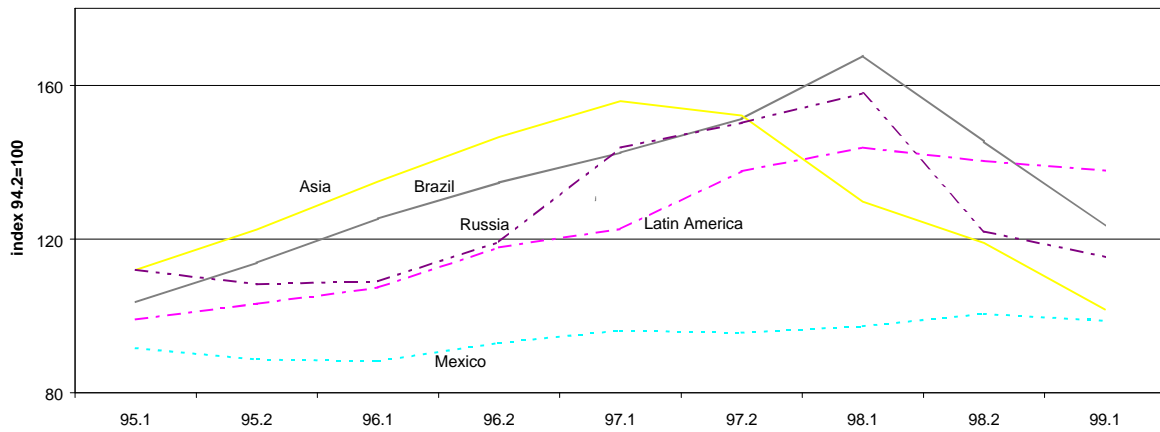
In this section, we analyzed in more detail the behavior of foreign investors. All the players reduced their exposure to Brazil after the Russian crisis. We concluded that although there was a contagion from Russia (more formal tests in section VI), the channel was probably not through a common lender. In the next section, we continue our analysis of the Brazilian crisis focusing on the aftermath of the crisis.

IV. The Aftermath of the Crisis – 1999

Brazil's macroeconomic performance during the crisis year was better than expected. Inflation did not explode, GDP did not collapsed, the government was not forced to restructure its public debt and, slowly, both nominal and real interest rates have been going down (see Table 1). This performance is partly due to the fact that the private sector was largely hedged at the moment of the crisis and was insulated from the immediate effects of the devaluation. In fact, the government born most of the costs of the devaluation by having its public debt increase by around 10 percent of GDP. Since debts have eventually to be paid, or at least not allowed to explode, the better than expected performance have to be judged against the feasibility of generating current and future fiscal surpluses in a country where sustained growth is long overdue and fiscal consolidation a novelty.

Brazil's better than expected macroeconomic performance has been achieved partly due to a more responsible fiscal policy. In the past Brazil has inflated its way out of past fiscal inconsistencies, using inflation as the means to finance deficits that otherwise could not be financed. The consequences were dear, inflation reached more than 1000 percent per cent, growth stalled and income distribution deteriorated substantially. This time Brazil has fulfilled the IMF-agreed target as shown in Table 7. Figure 11 shows that this effort could be successful in stabilizing the debt to GDP ratio, if sustained.

In contrast to the generalized expectation, inflation was extremely moderate in 1999, notwithstanding the large nominal depreciation that followed the floating of the exchange rate. Consumer price index (IPCA) increased only 9 percent this year and the expectations are of a 7 percent inflation next year. Of course, the exchange rate depreciation has a larger

effect on wholesale prices, but even the general price index (IGP) did not exceed 20 percent in 1999. The reasons for such a low passthrough of the exchange rate depreciation to inflation are related to: (a) a depressed level of demand after the crisis that discouraged the passthrough , (b) a previous overvaluation of the exchange rate that was corrected by the nominal devaluation, (c) a low initial inflation at the end of 1998 (see Goldfajn and Werlang, 2000).

Figure 11: TOTAL NET DEBT

Source: Banco Central do Brasil
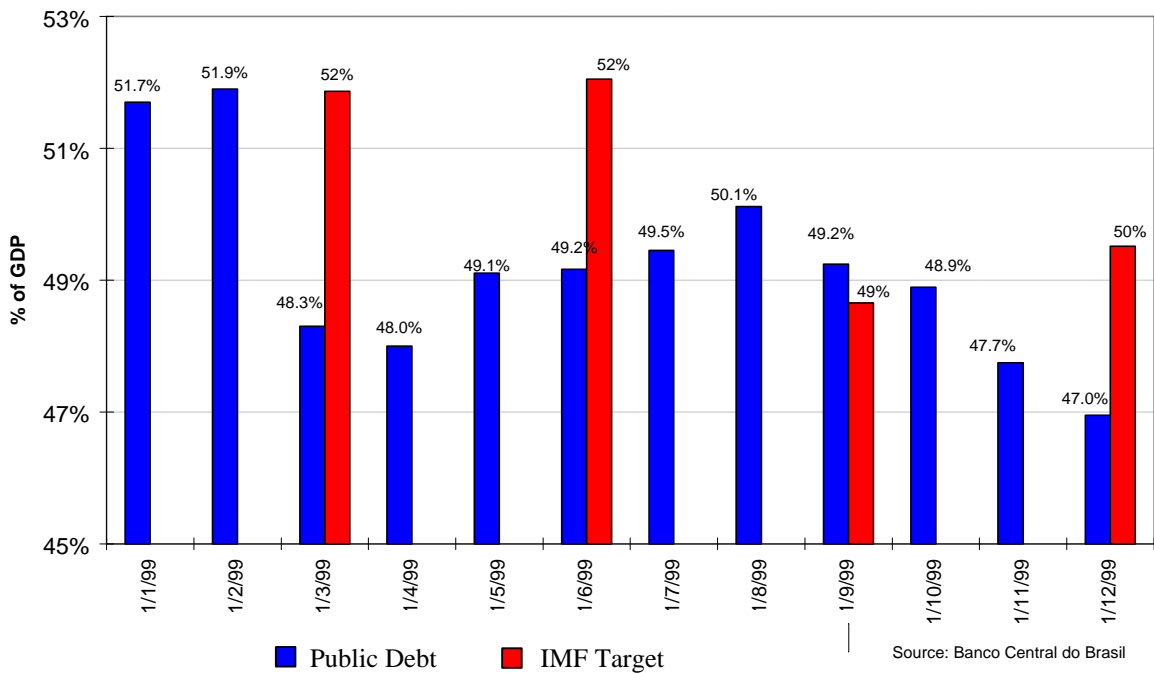
The combination of a very large nominal depreciation (60 percent) with a moderate inflation leads to an impressive 50 percent real exchange rate depreciation. This implies such a large change in the relative price of tradables in terms of nontradables that it is not surprising to realize that the relative price was not at a sustainable level, even taking into account the large negative terms of trade shock (around 20 percent) that Brazil has faced in the last 12 months. Figure 12 shows that although such a large real depreciation is not uncommon at the outset of the crisis, when the nominal overshooting is at work, it is unlikely that it will persist several months after the crisis.

Table 7: Primary Accumulated Deficit					IMF-Targets
	Observed				
	FEDERAL GOV. & BACEN	Municipal & State Gov.	Public enterprises	TOTAL	TOTAL
1998	4,845	(1,562)	(3,170)	113	
Jan/99	2,155	304	78	2,537	
Fev/99	3,931	454	709	5,094	
Mar/99	7,315	902	1,478	9,694	
Abr/99	8,564	1,484	743	10,791	
Mai/99	8,622	1,839	1,266	11,726	
Jun/99	12,536	1,978	961	15,475	12,883
Jul/99	16,267	2,050	2,107	20,424	15,626
Ago/99	19,264	1,798	4,110	25,172	20,590
Set/99	22,868	2,652	5,054	30,574	23,788
Out/99	23,643	3,064	5,335	32,042	26,078
Nov/99	24,018	3,721	5,159	32,899	27,763
Dez/99	**22,676**	**2,118**	**6,317**	**31,112**	30,185

Source: Banco Central do Brasil

Figure 12: Real Exchange Rate - Selected Crises Cases
**day before crises=100**
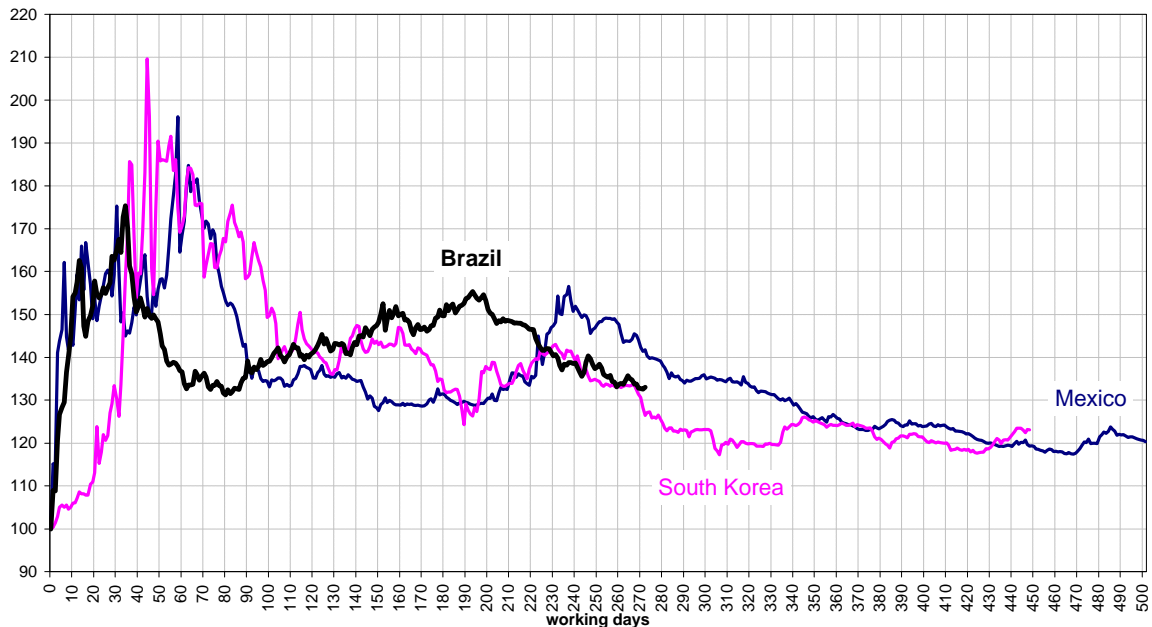
Source: Bloomberg

There are two ways to correct an undervalued exchange rate: with a nominal appreciation, through higher inflation or a combination of the two. Figure 13 illustrates the two possibilities that were available to Brazil, a Korea-style nominal appreciation or a Mexican-style depreciation-inflation spiral. Initially it seems that Brazil would follow the path with low inflation and a bit of appreciation but the Mexican path is always possible.

In fact, the observed reversal of the real exchange rate through either inflation (Mexico) or appreciation (Korea) is a more general phenomena. In several crisis cases, the degree of passthrough, the ratio of inflation to nominal depreciation, has increased systematically throughout the crisis . Figure 14 reveals that for 9 crisis cases in the recent past, either depreciation increased or inflation picked up, leading to a higher passthrough starting 6 months after the crisis. It seems that Brazil is following this trend.
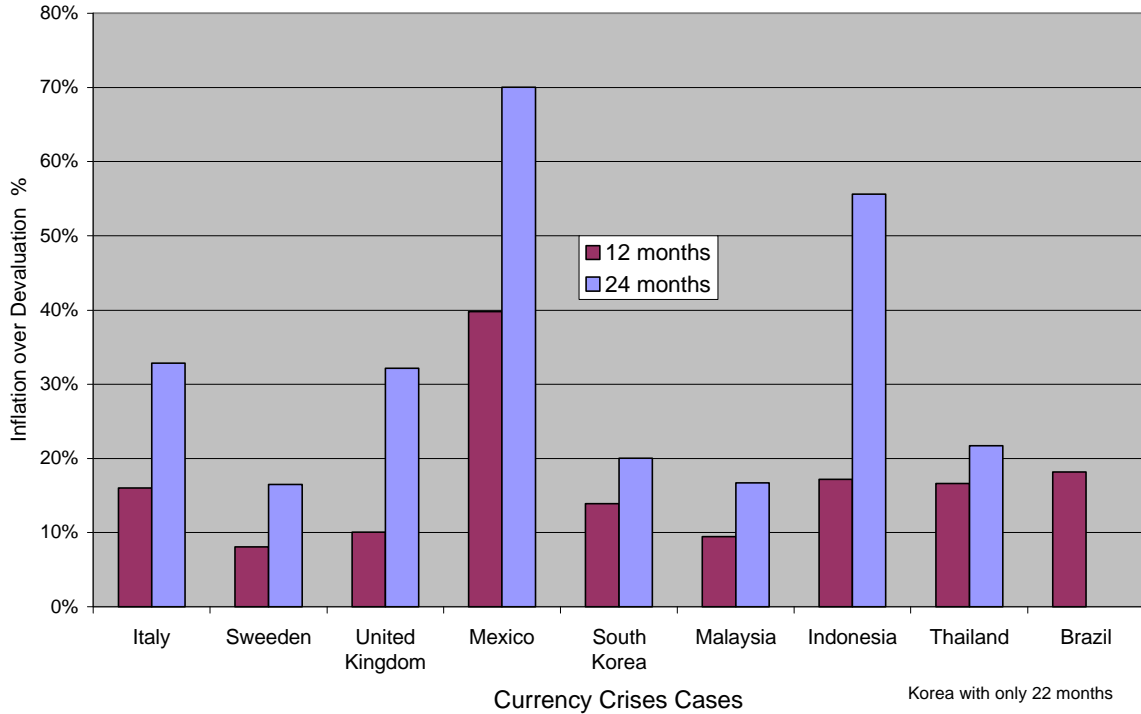
Figure 13: Nominal Exchange Rate - Selected Crises Cases
day before crises=100
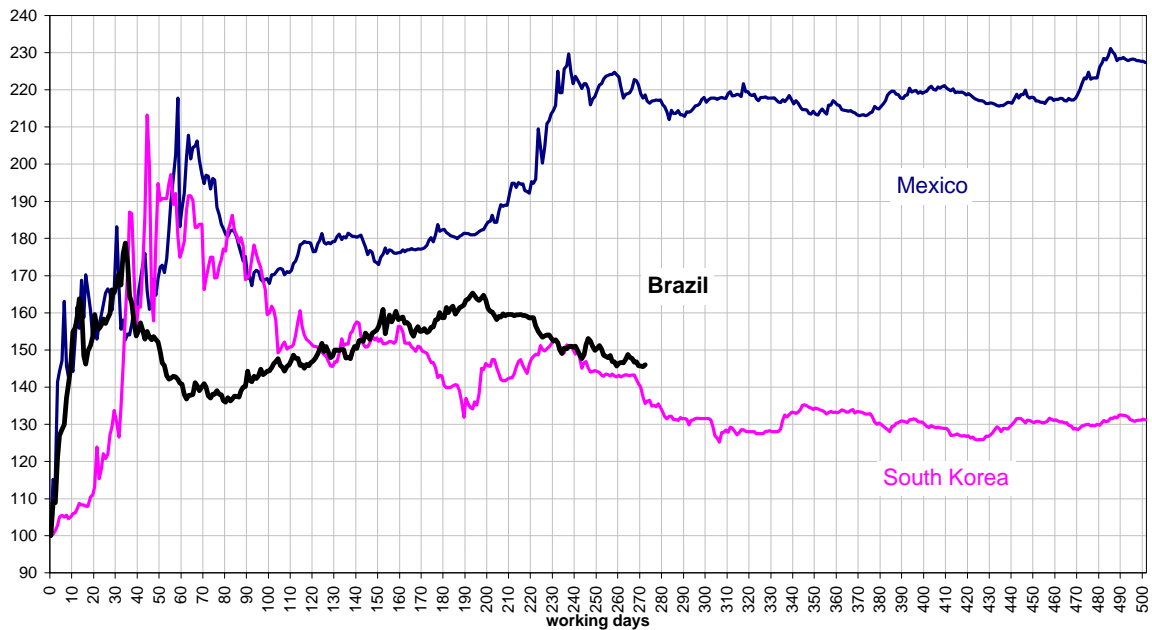
Source: Bloomberg

In the next two sections, we perform our econometric exercises, first on capital flows and then testing contagion from Russia.

Figure 14: Pass-through, Effect of devaluation on inflation (%)

Korea with only 22 months

V. Capital Flows to Brazil in the 1990's: Econometric Analysis

We now investigate the determinants of capital flows to Brazil. The ordinary least squares (OLS) regression controlling for heteroscedasticity and serial correlation is:

where *nf*, *i*, *i**, *Ee* are the net capital flows as a percentage of GDP, the domestic interest rate, the foreign interest rate, and expected devaluation, respectively, and *X* is a group of variables including domestic variables such as inflation, government spending, the real exchange rate, and a series of dummies for the Real Plan, the Tequila effect, the Asian crisis, the Brazilian crisis, and the Russian crisis . The data is in monthly frequency (see the appendix for formal definitions of the variables). The results are summarized in Table 8 - 9 below.

As predicted by theory, the coefficient of the international interest rate is negative and significant. This result is consistent with evidence for Latin America in Calvo and others

(1993), and with evidence f or developing countries in Fernández-Arias and Montiel (1995). The result is robust across specifications and to using either returns on U.S. Treasury bills or yields on 10-year Treasury bonds. The coefficient of the domestic interest rate adjusted for expected depreciation and the coefficients of other domestic factors do not help in explaining capital flows to Brazil. We interpret the results as evidence in favor of *push* effects as opposed to *pull* effects in explaining the surge in capital flows in the 1990's.

This result does not contradict our previous assertion that Brazil was vulnerable to a crisis and that the timing of the crisis was given by sudden large withdrawals of capital. The determinants of capital flows to Brazil in the long run are dominated by pull effects (foreign interest rates) but the composition of flows were determined by weak Brazilian fundamentals. In fact, the composition of capital flows was concentrated on short term portfolio flows that are prone to sudden spikes in capital flows. A better macroeconomic environment would imply a larger proportion of FDI in the overall capital flows (Figure 3 confirms that this is the case since 1999).

The dummies for the Tequila and Real plan are strong and significant. The Russian crisis has a strong negative coefficient but it is not statistically significant. This lack of significance is a bit surprising, since in sections II and III, in the higher frequency data, we observed a large withdrawal of capital during the Russian crisis. However, from a longer term perspective the Russian crisis did not in fact change the flows to the Brazilian economy. Capital inflows recovered and there was an important change in the composition of capital flows to Brazil with net foreign investment replacing other component of flows and partially dampening the effect of the Russian crisis.[4]

It is interesting to observe that in the period 1995-1999, in Table 9, the coefficient on international interest rate loses its significance. This suggests that the push effects have a

---

[4] The analysis and econometric regressions of the components of capital flows may be obtained directly from the author.

more long run effect, affecting capital flows only once large changes in international interest rates are factored in.

Table 8: Dependent Variable: Ratio of Monthly Total Net Private Capital Flows to GDP
Period: January 1988 - November 1999

Constant	4.78	4.95	5.28
	(5.05)	(5.14)	(2.69)
i^*	-0.64	-0.68	-0.79
	-(4.60)	-(4.68)	-(3.13)
$i - Ee$	-0.01	-0.13	0.02
	-(0.62)	-(0.64)	(0.50)
Tequila Dummy	-5.65	-5.96	-6.07
	-(5.60)	-(5.43)	-(5.33)
Real Plan Dummy	2.47	2.78	2.49
	(2.98)	(2.99)	(2.46)
Asian Dummy	2.73	2.41	2.42
	(2.99)	(2.42)	(2.42)
Russia Dummy	-	-4.60	-4.86
		-(1.63)	-(1.54)
Brazil Dummy	-	-0.56	-0.09
		-(0.47)	-(0.06)
Inflation Rate	-	-	0.01
			(0.28)
Ratio of Government spending to GDP	-	-	2.38
			(0.24)
Real Exchange Rate (deviation from equilibrium rate)	-	-	-2.48
			-(0.55)
Adjusted R^2	0.24	0.26	0.25

Note: T-Statistics in parentesis
Source: See Appendix I.

Table 9: Dependent Variable: Ratio of Monthly Total Net Private Capital Flows to GDP
Period: January 1995 - November 1999

Constant	24.83	42.75
	(1.20)	(2.23)
i^*	-3.87	-7.04
	-(0.99)	-(1.86)
i - Ee	-0.62	-0.42
	-(3.19)	-(0.94)
Asian Dummy	1.77	1.11
	(1.25)	(0.87)
Russia Dummy	-6.50	-8.00
	-(1.29)	-(1.67)
Brazil Dummy	-2.83	3.03
	-(1.07)	(0.40)
Inflation Rate	-	-0.27
		-(0.36)
Ratio of Government spending to GDP	-	-26.38
		-(1.05)
Real Exchange Rate (deviation from equilibrium rate)	-	-26.29
		-(0.87)
Adjusted R^2	0.05	0.09

Note: T-Statistics in parentesis

Source: See Appendix I.

VI. Testing Contagion

In the previous sections, we argued that the timing of the Brazilian crisis was a consequence of the contagion from Russia but we had not offered a formal tests of this proposition. This section fills this gap using primarily the sovereign spreads. Analyzing the currency market is not very useful as for most of the sample period, both the Brazilian Real and the Russian Ruble were fixed to the dollar. The currencies move about relatively freely only after January 1999 (when the Real peg unraveled), but that period leaves out many important phases of the crisis.

In order to understand the transmission of shocks from Russia to Brazil, we carry out a series of tests. We begin by looking at rolling correlations (at three month interval) between the relevant variables. We use granger causality tests and reduced form VARs to examine the direction of shocks between Russia and Brazil.

We then define crisis and tranquil periods, and test for significant changes in correlations between the two periods. We apply the Forbes and Rigobon (1999) methodology to adjust the crisis period correlations for sudden increase in variance (see Appendix). The motivation for this approach is to control for the correlation bias associated with higher variances, i.e. in the standard correlation formula, higher variances lead to higher correlations. Once the adjustment is performed, crisis period correlations can be tested for significant increases without the potential of this bias. We use the Forbes and Rigobon test with caution, as we are not sure a study of contagion ought to control for the increased variances that are an integral part of any crisis scenario. It could very well be that the factors behind the increased variances (thin markets, panic, institutional failure, etc.) are precisely what make up contagion, and controlling for these factors make test for contagion moot.

The tranquil period sovereign spreads correlations are substantially larger than what we saw in the stock market case. Using 106 observations from January – May, 1997, we find

the correlation to be 0.35. The spreads of both the bonds in discussion shot up even further in the crisis period (see Figure 15). The correlation of the spreads also jumped (see Table 10), and remained at very high levels till late 1998. The direction of the shock goes both ways, as at various periods the two markets appear to be Granger Causing each-other (see Table 11).

Table 10: Brazil-Russia Correlations
(Sovereign Spreads)

	Date	No. of Obs.	Unadjusted Correlation	Adjusted Correlation	t-stat
Tranquil Period					
	1/1997 5/1997	106	0.35		
Crisis Period					
Full Sample	09/1997 12/1998	335	0.94	0.32	-1.31
Three month windows	09/1997 11/1997	65	0.87	**0.97**	39.55
	10/1997 12/1997	66	0.82	**0.94**	33.00
	10/1997 01/1998	58	0.41	**0.85**	19.11
	12/1997 02/1998	57	0.51	**0.93**	27.21
	01/1998 03/1998	55	0.87	**0.99**	46.34
	01/1998 04/1998	62	0.86	**0.99**	54.63
	02/1998 05/1998	62	0.89	**0.99**	63.42
	04/1998 06/1998	62	0.91	**0.97**	40.67
	05/1998 07/1998	65	0.79	**0.86**	21.80
	06/1998 08/1998	66	0.98	**0.67**	10.73
	07/1998 09/1998	65	0.97	0.46	2.98
	07/1998 10/1998	64	0.85	0.27	-2.17
	09/1998 11/1998	63	0.29	0.50	4.23
	10/1998 12/1998	65	-0.03	-0.02	-9.04

Source: Bloomberg

bold denotes significance at 10% or lower

Impulse response function from the VARs show large and persistent shocks transmitting from both countries during the crisis period. The adjusted correlations for the spreads show significantly higher correlation during the crisis period sub-samples when compared to the tranquil period (see Table 10). All but two sub-samples in the crisis period

had significantly higher adjusted correlations. This confirms our findings from previous work (Baig and Goldfajn, 1998) that the correlations in the Brady markets are very high and increases significantly (even after the adjustment) during the crisis. This gives support to the fact that if there was a contagion from Russia to Brazil, the most likely place of the transmission was the off-shore Brady markets.

Table 11: Granger Causality Tests
(Financial Flows)

Sample	1/1/97-5/30/97			9/1/97-11/28/97			10/01/1997-12/31/1997			10/31/1997-1/30/1998		
Null Hypothesis:	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.
FLF1 does not Granger Cause OFF1	89	1.33	0.27	65	1.39	0.26	63	0.62	0.54	60	0.18	0.84
OFF1 does not Granger Cause FLF1		0.01	0.99		0.06	0.94		0.21	0.81		**4.40**	0.02
Sample	12/01/1997-2/27/1998			1/01/1998-3/31/1998			1/30/1998-4/30/1998			2/27/1998-5/29/1998		
Null Hypothesis:	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.
FLF1 does not Granger Cause OFF1	55	0.38	0.69	57	1.94	0.15	54	0.20	0.82	56	1.89	0.16
OFF1 does not Granger Cause FLF1		0.06	0.94		1.66	0.20		1.34	0.27		1.36	0.27
Sample	4/01/1998-6/30/1998			5/01/1998-7/31/1998			6/01/1998-8/31/1998			7/01/1998-9/30/1998		
Null Hypothesis:	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.
FLF1 does not Granger Cause OFF1	52	1.96	0.15	60	1.45	0.24	63	**2.88**	0.06	63	**2.62**	0.08
OFF1 does not Granger Cause FLF1		0.82	0.45		0.91	0.41		0.64	0.53		0.46	0.63
Sample	7/31/1998-10/30/1998			9/01/1998-11/30/1998			10/01/1998-12/31/1998			10/01/1998-12/31/1998		
Null Hypothesis:	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.	Obs	F-Stat	Prob.
FLF1 does not Granger Cause OFF1	60	**5.72**	0.01	56	**4.99**	0.01	57	**7.02**	0.00	56	0.08	0.92
OFF1 does not Granger Cause FLF1		0.45	0.64		0.88	0.42		1.52	0.23		0.99	0.38

OFF1: Official market financial net flows (see section III)
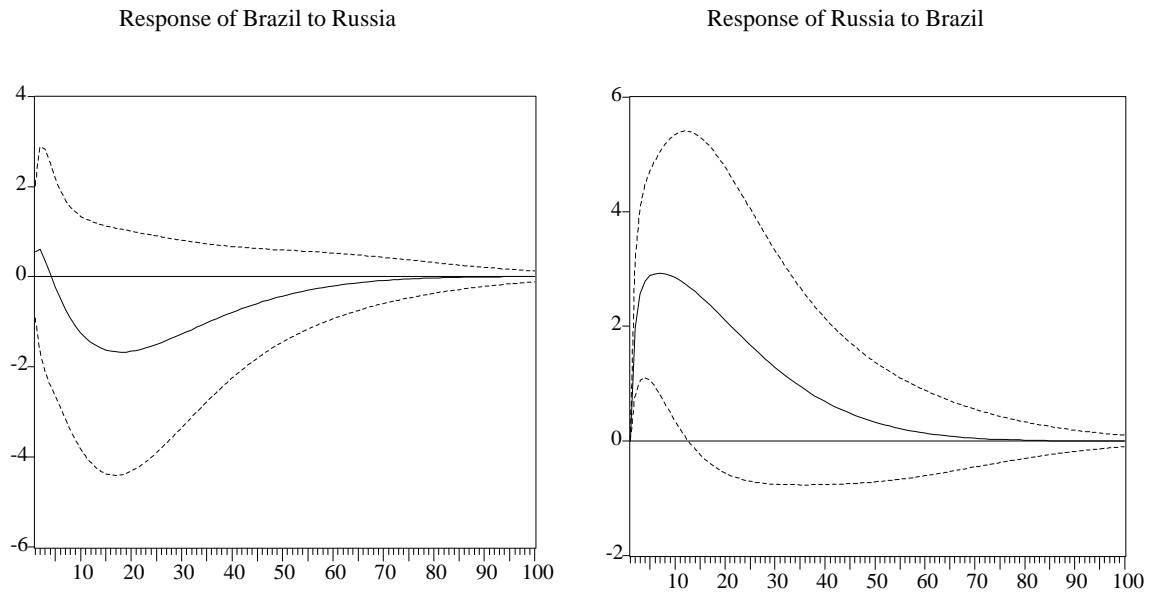**FLF1: Floating market net flows (see section III)**

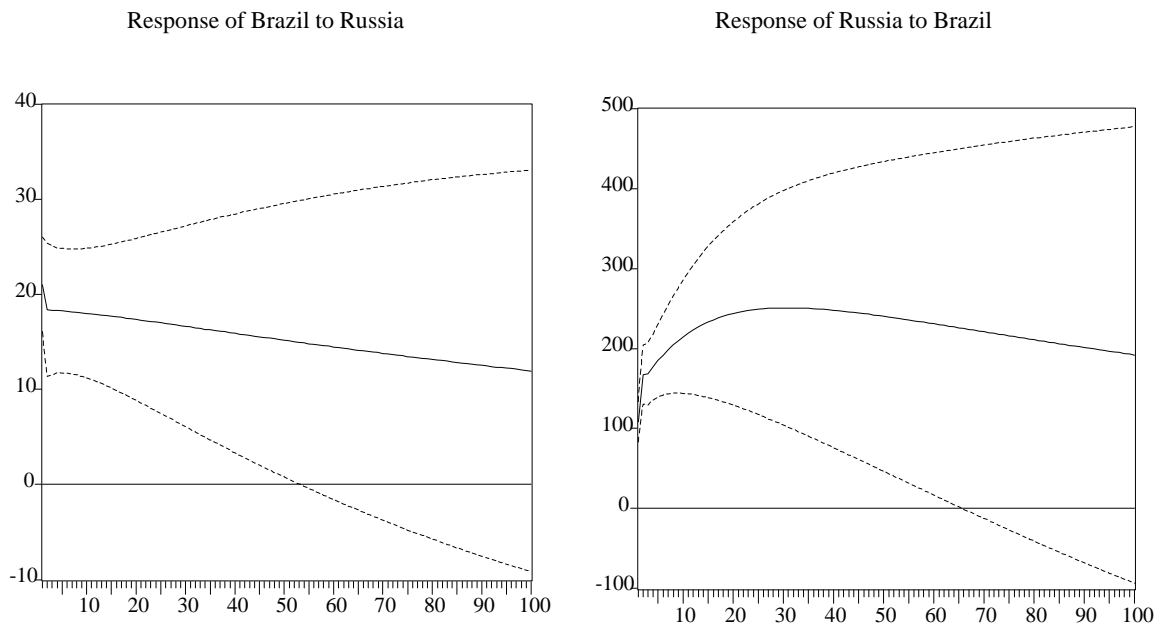*Note: Significant (within 10 %) values are in bold)*

Figure 15

Impulse Response Functions (from reduced-form VARs)

Sovereign Spreads Response (to one S.D. Innovation)

Tranquil Period (01/01/1997 05/30/1997)

Response of Brazil to Russia

Response of Russia to Brazil

Crisis Period (01/01/1998 12/31/1998)

Response of Brazil to Russia

Response of Russia to Brazil

IV. Conclusions

The paper has reached a few conclusions that are worth summarizing below. First, we argued that Brazil was vulnerable to a crisis given its fiscal policy and overvalued exchange rate. The timing of the crisis was given by an external event, the Russian crisis, and triggered by large withdrawals of portfolio flows. In the case of Brazil one cannot assert that a particular investor group had a predominant role in the crisis. If anything, the data suggest that while foreign investors (both banks and institutional investors) were long in Brazil, the speculation against the currency was not overwhelming and Brazilian policy makers could sustain withdrawals from Brazilians investors running from fear of devaluation. Once the position of foreign investors changed, the balance of forces was altered and the currency peg could no longer be sustained.

Second, using weekly data on foreign banks exposure to Brazil from the central bank of Brazil , we checked the hypothesis that liquidity needs and withdrawals were one of the reasons that determined the timing of the Brazilian crisis. We observed that German banks (known to have had a large exposure to Russia and were badly affected by the Russian crisis) had one of the highest rollover rates within the G7 and, therefore, the data does not seem to reflect a common lender channel through Germany. This does not contradict our previous finding that foreign investors triggered the Brazilian crisis. The common lender is just one of possible channels of contagion. It could well be the case that foreign investors adjusted their probability of Brazilian default once they observed the Russian crisis (for example, because of a default under an IMF program) or the Russian crisis could have triggered a pure herding behavior by foreign investors.

Third, using daily data on several financial data from Bloomberg, one can check the alternative hypothesis that it was the liquidity crisis in mature markets that timed the crisis in Brazil and not the Russian crisis. However, most of the action happens immediately after the Russian crisis both in the foreign exchange and the Brady bond markets, although the spreads on the latter market suffer a new blow during the LTCM crisis. Therefore, rather than

concluding in favor of LTCM effect on this market, this leads us to favor instead the argument that the Brazilian residents reinforced the speculation once they realize that the speculation now included also the foreign investors.

Fourth, Brazil's macroeconomic performance during the crisis year was better than expected. Inflation did not explode, GDP did not collapsed, the government was not forced to restructure its public debt and, slowly, both nominal and real interest rates have been going down. This performance is partly due to the fact that the private sector was largely hedged at the moment of the crisis and was insulated from the immediate effects of the devaluation. In addition, the reasons for such a low passthrough of the exchange rate depreciation to inflation are related to: (a) a depressed level of demand after the crisis that discouraged the passthrough , (b) a previous overvaluation of the exchange rate that was corrected by the nominal devaluation, (c) a low initial inflation at the end of 1998.

Fifth, the econometric exercise on capital flows suggests that there is evidence in favor of *push* effects as opposed to *pull* effects in explaining the surge capital flows. However, the push effects have a more long run effect, affecting capital flows only once large changes in international interest rates are factored in. This result does not contradict our assertion that Brazil was vulnerable to a crisis and that the timing of the crisis was given by sudden large withdrawals of capital. The determinants of capital flows to Brazil in the long run are dominated by pull effects (foreign interest rates) and the composition of flows were determined by weak Brazilian fundamentals.

Finally, the econometric test of contagion from Russia shows that the comovement between the variables is remarkable, specially with regards to the spreads on Brady bonds. This confirms our findings from previous work (Baig and Goldfajn, 1998) that the correlations in the Brady markets are very high and increase significantly (even after adjusting for the bias) during the crisis. This gives support to the fact that if there was a contagion from Russia to Brazil, the most likely place of the transmission was the off-shore Brady markets.

Bibliography

Baig, T. and Goldfajn, I. "Financial Markets Contagion in the Asian Crisis," *IMF Staff Papers*, 46, 167-195.

Baig, T. and Goldfajn, I. "The contagion from Russia to Brazil," Working Paper No 420, Department of Economics at PUC, Rio de Janeiro.

Calvo, Guillermo, Leonardo Leiderman, and Carmen Reinhart, 1996, "Inflows of Capital to Developing Countries in the 1990s," *Journal of Economic Perspectives*, Vol. 10, No. 2, pp. 123-39.

_____, 1993, "Capital Inflows to Latin America: The Role of External Factors," *Staff Papers*, International Monetary Fund, Vol. 40 (March), pp. 108-51.

Cárdenas, Maurício, and Felipe Barrera, 1997, "On the Effectiveness of Capital Controls: The Experience of Colombia During the 1990s," *Journal of Development Economics, 54(1) oct 97, pg 27-57*, Fedesarrollo, Bogotá, Colombia).

Cardoso, Eliana, 1997, "Brazil's Macroeconomic Policies and Capital Flows in the 1990s," WIDER Project on capital flows in the 1990s (unpublished, January).

_____, and Goldfajn, I. "Capital Flows to Brazil: The Endogeneity of Capital Controls, " *IMF Staff Papers*, 46, 167-195.

_____, and Rudiger Dornbusch, 1989, "Foreign Private Capital Flows," in H.Chenery and T.N. Srinivasan, eds., *Handbook of Development Economics* (Amsterdam: North-Holland).

Claessens, Stijn, Michael Dooley, and Andrew Warner, 1995, "Portfolio Capital Flows: Hot or Cold?," Harvard Institute for International Development: Development Discussion Paper No. 501 (Cambridge, Massachusetts).

Clements, Benedict, 1997, "The Real Plan, poverty and income distribution in Brazil", *Finance and Development*, 34(3), sep 97, pg 44-46.

Dooley, Michael, 1995, "A Survey of Academic Literature on Controls over International Capital Transactions," Working Paper 95/127 (Washington: Internacional Monetary Fund).

_____, 1996, "Capital Controls and Emerging Markets," *International Journal of Finance and Economics*, Vol. 1, No. 3 (July), pp. 197-206.

Fernández-Arias, Eduardo, and Peter Montiel, 1995, "The Surge in Capital Inflows to Developing Countries," Policy Research Working Paper 1473 (Washington: World Bank).

Folkerts-Landau, David, and Takatoshi Ito, 1994, International Capital Markets (Washington: International Monetary Fund).

Franco, G.B.F., 1996, "The Real Plan", *Essays in Internacional Finance* No 217, International Finance Section (Princeton University).

García, Marcio, and Alexandre Barcinski, 1996, "Capital Flows to Brazil in the Nineties: Macroeconomic Aspects and the Effectiveness of Capital Controls" *Quartely Review of economic and finance*, 38(3), fall 98, pg 319-57.

Goldfajn, Ilan, and Rodrigo Valdés, 1996, "The Aftermath of Appreciations," QJE, March, 1999.

Goldfajn, Ilan, and Werlang, Sergio, 2000, "The Passthrough From Depreciation to Inflation: a Panel Study", mimeo, Brazil.

Grilli, Vittorio, and Gian Maria Milesi-Ferretti, 1995, "Economic Effects and Structural Determinants of Capital Controls," Working Paper 95/31 (Washington: International Monetary Fund).

Harberger, A., 1986, "Welfare consequences of capital inflows," in A.C. Choksi and D. Papageorgiou, eds., *Economic liberalization in developing countries* (Oxford: Basil Blackwell).

Johnston, R. Barry, and Chris and Ryan, 1994, "The Impact of Controls on Capital Movements on the Private Capital Accounts of Countries' Balance of Payments: Empirical Estimates and Policy Implications," Working Paper 94/78 (Washington: International Monetary Fund).

Labán, Raúl, and F. Larrain, 1994, "Can a Liberalization of Capital Outflows Increase Net Capital Inflows?" Documento de Trabajo No 155, Instituto de Economía, Santiago, Chile.

Mathieson, Donald, and Liliana Rojas-Suárez, 1993, *Liberalization of the Capital Account*, Occasional Paper No. 103 (Washington: International Monetary Fund).

Soto, Marcelo, and Valdés-Prieto, 1996, "Es el control seletivo de capitales efectivo en Chile? Su efecto sobre el tipo de cambio real," Cuadernos de Economía, Año 33, No. 98, pp. 77-108 (April), Santiago, Chile.

APPENDIX I: Data Used in the Paper

- For the Brazilian stock market, we take daily closing figures from the Bovespa index, and convert them to US dollars by the end-of-day exchange rate. For Russia, we do the same, using the Moscou index. Converting the indices in dollars allows us to make keep our analysis uniform before and after the devaluation of the currencies. Source: Bloomberg

- For sovereign bonds, we use the spreads on the Brazilian C-Bond and the Russian Euro-bond (EB Russo - 2001). The spreads were calculated by subtracting the yield to maturity of treasury bill with same duration from yield to maturity of the respective bonds: Brazilian C-Bond; maturity: 4/15/2014, coupon: 8% variable – 6 months. Russian Eurobond; maturity: 11/2001, coupon: 9.25% fixed – 6 months. Source: Bloomberg.

- Financial flows are the balance of the foreign exchange transactions in the financial markets. Ultimately the government would have to balance the market balance in order to keep the exchange rate crawling peg. However, the changes in reserves do not neccesarily track down exactly the financial exchange flows because some of the transactions are settled with a lag period (30-days and so). Source: Central Bank of Brazil.

- The Central Bank of Brazil follows the maturing short term external liabilities of its banking system in a weekly basis. The short term obligations include interbank and credit lines. This survey based monitoring system was introduced on October 1998, after the Russian crisis and during the negotiations with the IMF

- BIS exposure data obtained from their semi-annual reports on www.bis.org

- Daily interest rates and exchange rates from Bloomberg.

- News dummies created by the authors using news obtained from Bloomberg.

Montlhy Database used in the Econometric Exercise on Capital Flows

- International interest rates: U.S. 3-month treasury bill rates from the Federal Reserve Bank of Saint Louis.
- Domestic interest rates in dollars: Short term rates on public debt treasury bills from Banco Central do Brasil discounted by the expected devaluation implicit in dollar futures contracts (first day of the month) from Bolsa de Mercadorias e Futuros (BM&F).
- Government spending: Federal government total expenditure, Banco Central do Brasil.
- Real exchange rate: Deviations from equilibrium real exchange rates calculated as in Goldfajn and Valdés (1996).
- Inflation: Changes in the general price index, Índice Geral de Preços (IGP-DI), Fundação Getúlio Vargas.

- Total net private flows: From Brazil's central bank's montlhy statistics on "capital movement". Mntlhy "capital movement" statistics do not include short-term capital flows and reinvested profits. See table 2 of this paper for the composition of total flows: net direct investment corresponds to line 1 in table 2, equity securities correspond to line 5, debt securities to line 6, and total net private flows correspond to the sum of these three flows.
- Nominal monthly GDP: From Banco Central do Brasil.

APPENDIX II : Forbes and Rigobon (1998) adjustment

Fobers and Rigobon (1998) show that the estimated correlation between two stochastic variables, *x* and *y*, increases when the variance of *x* increases—even if the actual correlation between *x* and *y* does not change. The standard, unadjusted correlation coefficient is conditional on the variance of *x*. They show that the bias can be quantified as follows:

$$r_t^u = r_t \sqrt{\frac{1+d_t}{1+d_t\, r_t^2}}$$

where,

r_t^u : *unadjusted correlation coefficient*

r_t : *actual correlation coefficient*

d_t : *relative increase in* var*iance of* x_t

Manipulating the above equation yields:

$$r_t = \frac{r_t^u}{\sqrt{1+d_t[1-(r_t^u)^2]}}$$

We use the above methodology to adjust the above methodology to adjust the crisis period correlations.